Automation of Telecom Networks by Using Robot Framework

Godasu Swetha, T. Ramaswamy, S.P.V. Subba Rao

Abstract--- Telecom industry is becoming a top performing industry in the last few years. It is facing a unique set of challenges in order to meet the customer demands and the technology front due to its wide range of sectors. To meet those challenges till date a lot of human/manual intervention is required for Telecom services. Quality of service is not good, it consumes more time and cost is more due to human/manual intervention Telecom services. To overcome all these problems most of the industries approach Automation methods. But till date, only commercial automation tools are available in the market to automate SIP. License cost of commercial automation tools create a major problem and requires skilled automation engineers who should have knowledge of the script programming. This paper presents an Open source Robot Framework automation solution for Telecom Services. In this project Telecom libraries are implemented by using Python and Robot framework scripts are written for automation of Telecom Networks. Also implemented virtualized IPPBX, Xlite (Softphone), Cisco7940 as part of this project. As Robot framework is an open source, the cost of the Telecom network automation is reduced and it is keyword driven framework so that less a number of skilled engineers are required these are the main advantages of this project.

Keywords--- Telecom Networks, Robot Framework, IPPBX, Xlite, Cisco7940, Python.

I. INTRODUCTION

Current VoIP (Voice over Internet Protocol) environment is mainly based on the SIP (Session Initiation Protocol) as proposed by IETF (Internet Engineering Task Force). Under conventional SIP structure, Proxy Server will be used before the communication starts between two communication sides.Time, Quality and Cost are the main characteristics of the development of the Telecom network. For enhancing the quality of Telecom networks, there are several methods which are adopted by the Telecom companies. Automation and manual testing are the well-known methods which are majorly used. Automation accomplishes the Quality and Time characteristics for any TeleCom applications[2].

Most of the Telecom industries prefer commercial automation tools because of the features provided by the tools. But the license cost of the commercial automation tools creates a big budget problem[3]. Apart from the cost of the automation tools, skilled automation engineers are required who should have domain knowledge of the application as well as script programming knowledge. One smart solution to this problem is Robot Framework automation[4].

A Robot Framework automation is the adjustment of assumptions, ideas, and tools that provide some core performances such as functioning, monitoring and reporting[5]. There is a large number of approaches to test automation, and all have a different way of working[6].

The main idea of this research work is to implement Telecom libraries by using python and written Robot Framework scripts for automation of telecom networks. And also implemented virtualized IPPBX, Xlite and Cisco7940 as part of this project.

II. SYSTEM ANALYSIS

Existing system

Till date so much manual intervention is required in TeleCom networks. So, TeleCom service providers are trying to automate end to end networks by using expensive commercial tools. Different kinds of commercial tools are being used to automate VoIP communication platforms like Spirant VoIP tool, Abacus, and etc. There is no particular open source tool is available to automate VoIP platform.

The Internet protocol network is connecting VoIP together allowing a user to make a free call from anywhere in the world with the availability of a stable internet connection. Vast growth in Telecom Networks requires a hardware module and software engineers to add more extensions or phone lines. As extensions are rapidly increasing, in some cases there may be a requirement for a new phone system. Not so with an IPPBX, a standard computer can easily handle a large no. of phone lines and extensions just add more phones to your network to expand[6]. In this VoIP platform if it is manual process it takes more time, more no. of skilled engineers are also required and also there is a possibility of erroneous results. So that, VoIP communication platform can be automated.

Proposed system

This paper is an attempt to implement an automation framework to automate Telecom networks by using an open source tool called Robot automation framework. Robot Framework is a reliable and simple resource. In this approach, TeleCom libraries/test scripts being implemented by using Python and written robot scripts for automation of Telecom Networks.

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And also Virtualized IPPBX (Internet Protocol Private Branch Exchange), Xlite (Softphone), And CISCO 7940 (IP phone) are implemented as part of this project. Virtualized IPPBX, Xlite and CISCO 7940 can be formed as a VoIP communication platform. VoIP communication platform can be automated by using Robot framework. As VoIP platform can be operated automatically it takes less time, Less no. of engineers are required and there is no possibility of erroneous results.

Feasibility study

a) *Operational feasibility*: It is very much easier to operate, unlike the human intervention VoIP communication platform. This project has been proposed in a user-friendly environment where the network requirement is very less and less no. of skilled engineers are required because the robot automation framework is a keyword driven framework so that the engineers who are first-time programmers they can also easily understand and they can also write test scripts easily.

b) *Technical Feasibility*: Robot framework scripting is easier to write. Any parishioner can understand robot framework scripts. The network complexity is very less. A processor with 1GB RAM or more, strong internet connection and an IP phone requires for this project.

c) *Cost feasibility*: Most part of the project is having software and that is being used here is all are available for Open source, the setup cost is very less. IP phone and stable internet connection are required to make a call.

III. OVERVIEW OF TECHNOLOGY USED

3.1 VoIP (Voice Over Internet protocol)

VoIPis a protocol enhanced for the transmission of various types of data (Voice, video, files, pictures or multimedia messages) from a source to a destination through the Internet Protocol or other packet switched networks.

VoIPis frequently used to refer to the actual transmission ofvoice (rather than the protocol implementing it).Regardless of a number of technological issues, real-time multimedia transmission (voice and video) over IP networks and the Internet has to a great extent been worked out. Voice data transfer rates have reduced to 6Kbits/sec from 64Kbits/sec by Advanced data compression techniques.

VoIP can conceivably enable users to call worldwide at no charge (except for the fee paid to service providers for Internet access).

A user's IP address basically turns into a phone number. Additionally, computer-based phone systems can be linked to servers that run a variety of interesting telephony applications, including PBX services and voice messaging [1].

The service limitations of the traditional telephone system are one of the best reason to support Packet telephony.

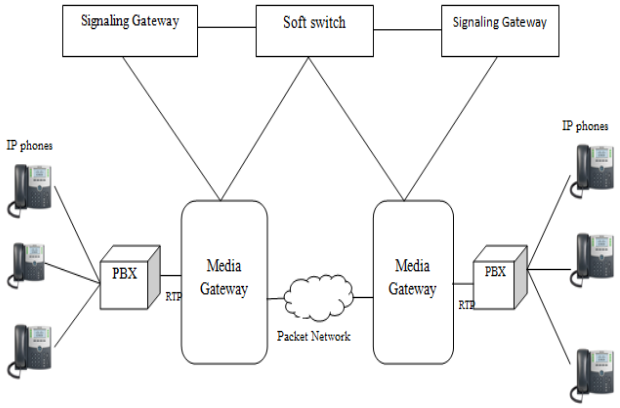

Fig 1: VoIP Architecture

3.2 Session Initiation Protocol (SIP)

SIP has got enormous support from the Telecom industries and it became the leading signaling protocol of VoIP because of its scalability, lucidity, and adaptability which is defined by the IETF(Internet Engineering Task Force). IMS(Instant Message System), VoIP and Net Meeting Systems are the extended applications based on SIP[7]. The Internet is having numerous applications which require the session creation and management, where a session is treated as an exchange of data between participants who are associated with that session.

The operation of these applications is sophisticated by the process of participants: users may move between endpoints, they may be addressable by multiple denominations, and they may communicate in several different media sometimes simultaneously. To carry different forms of real-time multimedia session data such as voice, video or text messages there are numerous protocols have been authored. The Session Initiation Protocol (SIP)[8] works in recital with these protocols by enabling Internet endpoints (called user agents) to find one another and to accede on an identification of a session they would relate to sharing [9].

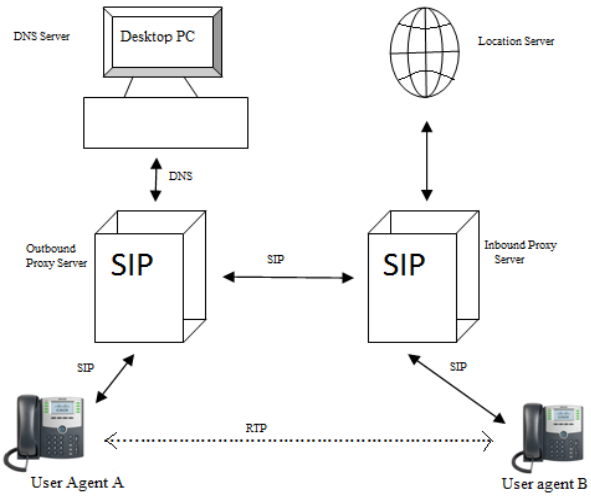

Fig 2: SIP Architecture

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3.3 IPPBX (Internet Protocol Private Branch Exchange)

An IPPBX or VoIP phone system replaces a conventional PBX and offers employees with an extension number, the flexibility to the conference, transfer and dial other colleagues. All calls are sent via data packets over a data network instead of the conventional phone network. Telephone calls can be provided through IP data networks which isa complete telephony system . Generally an IPPBX system is a piece of software running on a server[10]. Usually, a server can act as the VoIP system's connection to the internet and also it performs other tasks when the workload is more on the server[11].

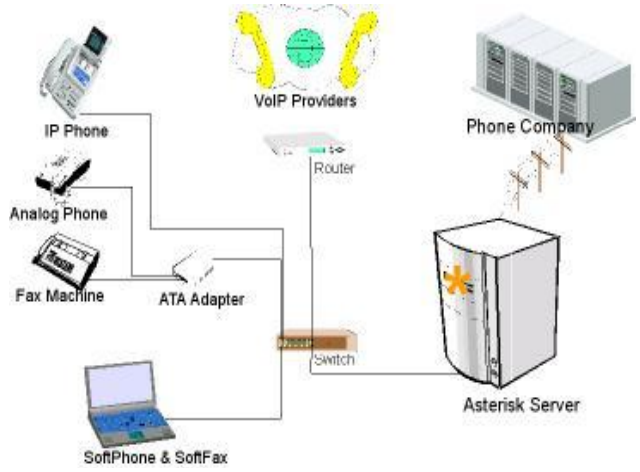

Fig 3: IPPBX Architecture

An IP PBX or IP Telephone System consists of one or more SIP phones, PSTN lines are often connected to an IP PBX server and optionally a VoIP Gateway. The IP PBX server functions in a similar manner to a proxy server: SIP clients, being either softphones or hardware-based phones, register with the IP PBX server, and when they wish to make a call they ask the IP PBX to establish the connection. The IP PBX consists of all phones/users and their corresponding SIP address and thus is able to connect an internal call or route an external call via a VOIP gateway.

3.4 ASTERISK

Asterisk is an open source free software utilizing VoIP execution of PBX. Like Hardware PBX, Asterisk PBX(Virtualized PBX) enables a client to make calls to one another utilizing softphones and ready to interface with othertelephone Networks including PSTN. Asterisk isn't restricted to One-To-One call; it can give various services including call conference, text messaging, voicemail, music on hold, call hold and call forwarding. Security was also the main attribute of this research project[12].

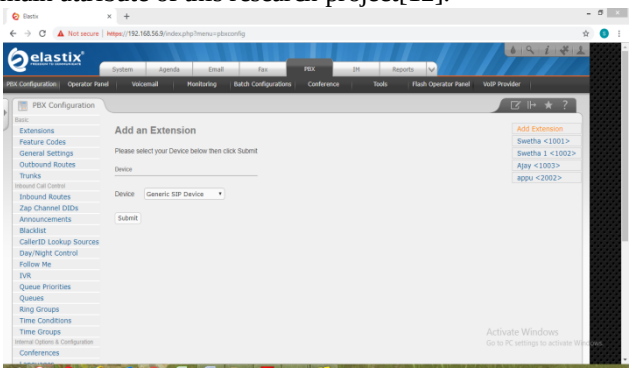

Fig 4: Virtualized IPPBX (Asterisk server)

Asterisk is helpful for implementing flexible PBX platform with low-cost hardware, which is feasible by host processing of DSP and TDM. Multiple packet voice protocols can be supported by Asterisk. High-level PBX applications provided by Asterisk. PBX can be created and compose multiple functions, features, and quality of traditional telephony switches are allowed by Asterisk[13]. Other PBX systems are very hard to implement and expensive too compared to Asterisk. In this voice and data, networking is handle with low maintenance cost and with flexibility. Asterisk can be integrated with the analog phone, IP phone and softphone[14].

In this paper, the Asterisk server is implemented for basic call setup between desktop Xlite softphone and Cisco 7940(IP phone).

3.5 Robot Framework

Robot framework is developed by NOKIA siemens communication technology Limited Company. It is based on python language and it is open source. It is keyword driven automated test framework. Test cases are organized by HTML or TSV files, while the data can be composed in four parts: Settings, Variables, Test cases and keywords[15].
Robot framework is introduced automation testing not only for that, it can advance the testing competence, reduces software, reduces reverting testing, and it is very easy to use due to its keyword driven nature. It provides Test libraries and other functions not only in python it can provide in java also. Robot Framework is versatile, in its application and technique is independent of each other[16]. At the same time, it is a set of automated testing tools.

Advantages of Robot framework

- Empowers testers to automate and manage scripts efficiently by Keyword-driven test automation framework
- OS and Application independent
- Provides easy to read reports and logs in HTML format, with detailed logs and clear test reports
- Has a rich set of built-in libraries & rich ecosystem.
- A simple Library API is provided for creating customized test Libraries
- Has simplicity in developing Test Cases in .txt, .html, .xml, .csv etc.
- License cost: Nil, as its open source
- Enables easy to use tabular syntax for creating test case in a uniform way
- Plugins are available for Common CI (Continuous Integration) and Build Tools. Ex: Jenkins, Ant, Maven, Test Link etc…
- Provides support for Selenium for Web Testing

High-Level architecture

The robot framework architecture can be broadly divided into 4 integral parts namely.

- Test data
- Robot framework
- Test library
- System Under Test (SUT)

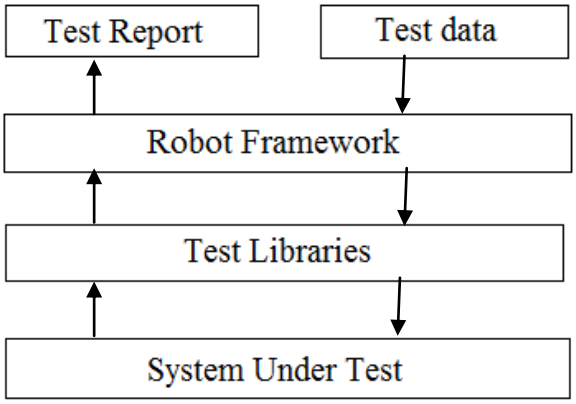

Fig 5: Robot Framework high-level Architecture

Test data: Test data is nothing but the input format of any test cases either in TSV or HTML format. Robot framework handles the processing of the test data, the controlling of test execution and the reporting of results for testing. The test data can't directly interact with the SUT and hence robot framework acts as a bridge between the test input and the test libraries.

Robot framework: As shown in the figure, Robot framework's role in a test framework is to take test data and process it into a format that is appropriate for the attached test libraries. It means to invoke the test libraries with the appropriate arguments of the received data about the test from the test libraries and report it. It must be run on Python or Java.

Test Libraries: The test libraries are responsible for interacting with the target under test and resulting in the formation of reports. The testing and interaction with the target under test are basically done by test libraries that are plugged into Robot Framework, which can be developed either in Java or Python or in any native code. Optionally test libraries may internally use other test tools, but this is not visible to Robot framework.

System Under Test: There should be an application for test. Here in this robot automation framework, VOIP communication platform is implemented for the testing.

IV. IMPLEMENTATION

The installation of IPPBX (Asterisk) server

- Install CentOS 6.7(Linux version) on VMware (CentOS 6.7 is a Linux version which is compatible with Asterisk).
- On top of CentOS, Install Asterisk(IPPBX) software.
- Configure GUI(Graphic User Interface) for IPPBX.
- Configure extensions, i.e., SIP protocol details in the IPPBX.
- Install softphone in clients and configure Xlite in a system(IPPBX Server).
- Configure the Cisco phone.

Installation and configuration of Robot framework

- Download and install Python 2.7.14 and PIP which is python packages manager.
- Install, compile and configure Robot framework.
- Write Python based Robot framework test script for automation of basic SIP call between Xlite and Cisco7940.
- Execute the test script and find the report and logs in HTML format.

Result verification

- Install and configure Wireshark 2.4.2 (64-bit)
- Validate result of SIP call flow in Wireshark.

4.1 Robot Framework for Sip Automation Test Bed

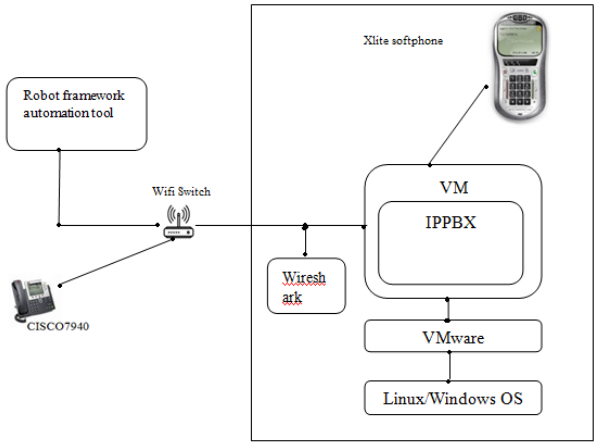

Fig 6: SIP communication platform with automation

Software required:

- Python MSI Installer package
- Robot Framework Exe
- IPPBX: Asterisk
- Softphone: Xlite
- Telnet Library
- Wireshark
- OS: Linux Fedora Core

Hardware required:

- A generic PC
- Stable Network Connection
- Cisco 7940 IP phone

In SIP automation test bed, generally there are 2 main components: They are

- IP phones / 3PCC phones(CISCO 7940) automation
- Softphone automation(X-lite)

IP phone/3PCC phone automation by Using Robot Framework

CISCO phone can be automated by connecting the CISCO phone using Telnet library and issue the required Cisco IP phone commands by using keywords provided in the Robot framework.

E.g: To make a sample SIP call to find the some of the basic CISCO commands below
test open -- To open the session
test ky spkr --This will off-hook the call by pressing speaker button of CISCO phone
test ky xxxx -- To make the call to xxxx extension by pressing xxxx DTMFs
test ky spkr -- This will on-hook the call by pressing speaker button of CISCO phone
test close -- To end the connection path

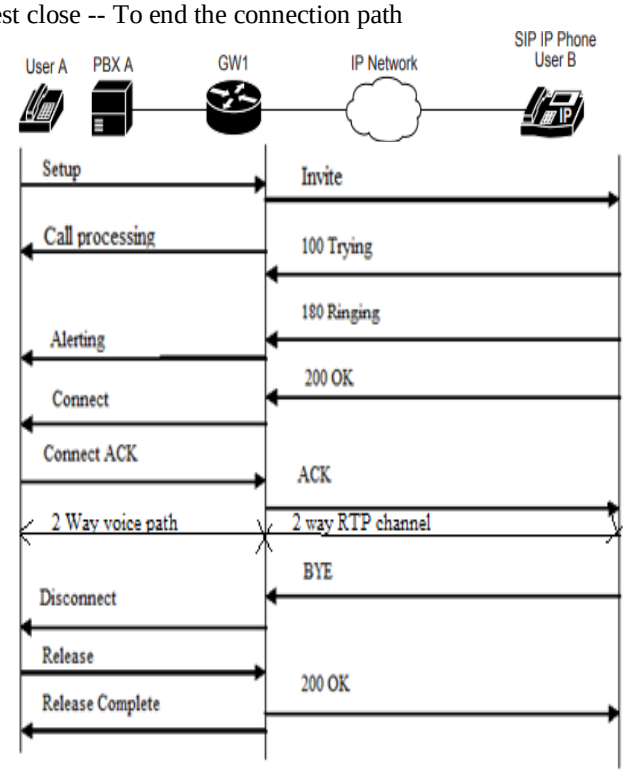

Fig 7: Basic SIP call flow with a proxy server

SOFTPHONE AUTOMATION: To automate softphone (Xlite/Zoiper) GUI importing pywin auto and to find Xlite/Zoiper DTMF using Robot framework - Sikuli Library. Mainly it is used to automate the snapshots of the pictures taken in order to enter the number and to off-hook or on-hook the call.

WIRESHARK VALIDATION: Wireshark is used for validation of SIP-based output call flows.

V. RESULTS

The current implementation of Virtualized SIP communication platform can be automated by using an Open source tool called Robot Framework with high Quality and low cost. The communication platform includes /two users, with their respective user IDs. Wireshark is used to analyze packets of data which are acquired by results. The SIP call flow traces can be seen in the Wireshark and related comments can be verified by using Wireshark. Robot Automation framework test scriptsresults can also be verified in log.html, report.html, and output.html formats to know about the status of the project and how much time was taken by the project to complete. The Wireshark traces and comments can be seen in below figures.

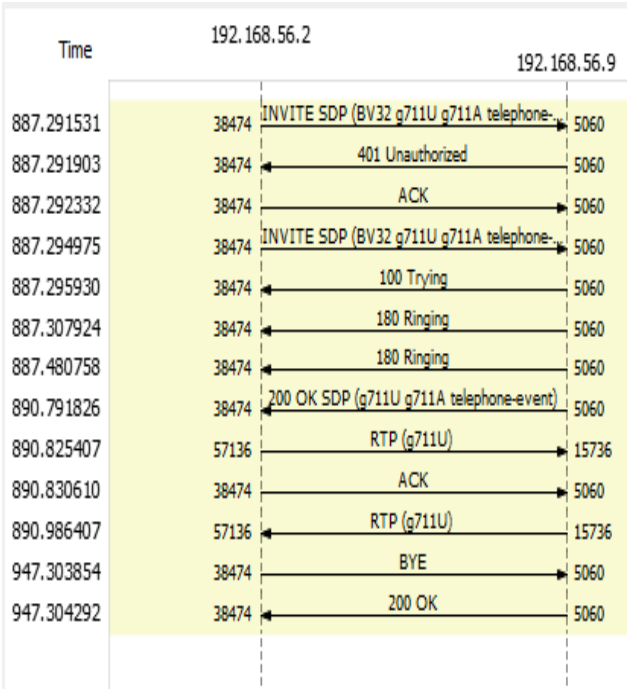

Fig 8: Basic call flow captured in Wireshark

Fig 9: Comments of a Basic call flow

VI. FUTURE SCOPE

In this paper, the basic SIP call between Xlite and Cisco7940 phone is automated with Robot Framework. By using Cloud computing SIP calls can be connected to the people worldwide. In future SIP features can also be automated by using Robot Framework. By using Robot Framework we can automate cutting-edge technologies in telecom like Netconf, 5G, Cloud SDN etc. Nowadays Robot Framework is supported by RPA (Robot Process Automation). Robot Framework is an Open source most of the companies going to use with low price.

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